

Original citation:

Potter, Rachel, Sheehan, Bart, Cain, Rebecca, Griffin, James and Jennings, Paul A.. (2017) The impact of the physical environment on depressive symptoms of older residents living in care homes : a mixed methods study. The Gerontologist .

Permanent WRAP URL:

<http://wrap.warwick.ac.uk/88815>

Copyright and reuse:

The Warwick Research Archive Portal (WRAP) makes this work of researchers of the University of Warwick available open access under the following conditions.

This article is made available under the Creative Commons Attribution 4.0 International license (CC BY 4.0) and may be reused according to the conditions of the license. For more details see: <http://creativecommons.org/licenses/by/4.0/>

A note on versions:

The version presented in WRAP is the published version, or, version of record, and may be cited as it appears here.

For more information, please contact the WRAP Team at: wrap@warwick.ac.uk

The impact of the physical environment on depressive symptoms of older residents living in care homes: a mixed methods study

Dr Rachel Potter (corresponding author)
Warwick Clinical Trials Unit, Warwick Medical School
University of Warwick
Coventry, UK
r.potter@warwick.ac.uk

Dr Bart Sheehan
Centre for Rehabilitation Research in Oxford
University of Oxford
Oxford, UK
Bart.Sheehan@ouh.nhs.uk

Dr Rebecca Cain
Warwick Manufacturing Group
University of Warwick
Coventry, UK
R.Cain.1@warwick.ac.uk

Dr James Griffin
Warwick Clinical Trials Unit, Warwick Medical School
University of Warwick
Coventry, UK
James.Griffin@warwick.ac.uk

Professor Paul Jennings
Warwick Manufacturing Group
University of Warwick
Coventry, UK
Paul.Jennings@warwick.ac.uk

Abstract

Purpose of Study

40% of residents living in care homes in the United Kingdom have significant depressive symptoms. Care homes can appear to be depressing places, but whether the physical environment of homes directly affects depression in care home residents is unknown. This study explores the relationship between the physical environment and depressive symptoms of older people living in care homes.

Design and Methods

In a prospective cohort study the physical environment of 50 care homes were measured using the Sheffield Care Environment Assessment Matrix (*SCEAM*) and depressive symptoms of 510 residents measured using the Geriatric Depression Scale (GDS-15). The study was supplemented with semi-structured interviews with residents living in the care homes. Quantitative data were analysed using multi-level modelling, and qualitative data analysed using a thematic framework approach.

Results

The overall physical environment of care homes (overall *SCEAM* score) did not predict depressive symptoms. Controlling for dependency, social engagement, and home type, having access to outdoor space was the only environmental variable to significantly predict depressive symptoms. Residents interviewed reported that access to outdoor space was restricted in many ways: locked doors, uneven foot paths, steep steps, and needing permission or assistance to go outside.

Implications

We provide new evidence to suggest that access to outdoor space predicts depressive symptoms in older people living in care home. Interventions aimed at increasing access to outdoor spaces could positively affect depressive symptoms in older people.

3-5 key words

Depression

Built environment

Prospective cohort study

Outdoor space

Introduction

About 3% of older people live in care homes in the UK, a figure which has remained stable for the last decade, despite a growing elderly population according to the Office for National Statistics (2014). In the UK care homes are either nursing homes (provide nursing care and are required to employ at least one qualified nurse 24 hours a day) or residential homes (care homes without nursing that provide meals and personal care such as help with washing and dressing); some care homes are dual-registered and provide both residential and nursing care beds. With the exception of those aged 95 and over, older people most commonly move into care homes in the UK because they are no longer able to live independently at home due to significant physical and mental health problems, rather than general frailty or social reasons (Help The Aged, 2008; Lievesley, Crosby, & Bowman, 2011). The majority of residents require help with mobility, more than half have dementia, stroke or other neurodegenerative disease (Lievesley et al., 2011), and notably over 40% have depressive symptoms (Llewellyn-Jones et al., 1999; Mann, Graham, & Ashby, 1984; Underwood et al., 2013). In care home populations, depression is associated with functional decline, dependency, pain, loneliness, and increased mortality (Cuijpers & Van Lammeren, 1999; Eisses et al., 2004; Sutcliffe et al., 2007). In contrast with studies of older people living in the community, no relationship between depression and gender has been found in care home residents (Jongenelis et al., 2004). Residents' describe how social isolation, lack of privacy, sharing facilities, and ambivalence towards sharing with cognitively impaired residents influences feelings of depression (Choi, Ransom, & Wyllie, 2008); suggesting that factors unique to the care home environment may also affect mood.

There has been a growing interest in the role of the physical environment on health since the seminal work of Ulrich, who found patients with rooms with windows looking at a natural scene had shorter hospital stays (Ulrich, 1984). Research on effects of physical environment on mental health has focused on psychiatric wards; with a systematic review finding that private space and more home-like environments may enhance patient wellbeing, but noting major methodological shortcomings in study designs (Papoulias, Csipke, Rose, McKellar, & Wykes, 2014).

For older people, the aim of good design is to support functional and cognitive abilities (Lawton & Nahemow, 1973). In care home settings there is growing evidence to suggest the physical environment may influence the physical health, behaviour, and quality of life of residents (Anderiesen, Scherder, Goossens, & Sonneveld, 2014; Garre-Olmo et al., 2012; Parker et al., 2004; Whear et al., 2014). Few studies have explored the impact of the physical environment on depressive symptoms. Brighter lighting reduced depressive symptoms in residents in assisted living facilities in the Netherlands (Riemersma-van der Lek et al., 2008) and camouflaged exits and silent locks rather than alarms were negatively associated with depressive symptoms in homes for residents with dementia (Zeisel et al., 2003).

Recognising and managing depression in care homes can be problematic, with fewer than half of cases detected or treated (Davison et al., 2007; Underwood et al., 2013). If the physical environment does affect depressive symptoms of residents living in care homes, interventions manipulating design features of care homes could be relatively simple to implement and could potentially benefit residents.

Design and Methods

This is a mixed methods study comprising of a small qualitative interview study and a large prospective cohort study.

Context of the study

Participants selected for the interview study and prospective cohort study were part of the OPERA trial, a cluster randomised trial exploring the effectiveness of a physical activity intervention to reduce depression in older people living in care homes (Underwood et al., 2013). In brief, the OPERA trial recruited 78 care homes with between 16 and 70 beds in two locations in the UK; Coventry and Warwickshire and northeast London. Of these, 18 were nursing homes (care homes providing nursing care) and 60 residential homes (care homes without nursing care). Care homes were excluded when fewer than six residents were likely to take part in the study, or when most residents either had severe cognitive impairment or were non-English speaking. The trial recruited 891 participants, all permanent residents aged 65 or over. Residents who were too ill to approach or the care home manager believed it was inappropriate to approach at the time of recruitment, had severe communication problems or terminal illness were excluded from the trial; detailed descriptions of the methods are available elsewhere (Underwood et al., 2011).

Interview study

Initially we carried out the small interview study to explore what residents thought about the design of the care homes they lived in. The purpose of the interview study was to understand which aspects of care home design were important to investigate further in the prospective cohort study, and in particular to confirm that the tool we proposed to use to measure the physical environment of care homes in the prospective cohort study appeared to capture features that may affect mood. We also anticipated that the findings of the interview study could help the interpretation of the results of the predominant prospective cohort study.

We conducted 15 semi-structured interviews with residents from four care homes that had taken part in the OPERA trial. The four homes were purposively selected to represent a range of different care home design features to discuss, including: building type (purpose built or converted), size (small <30 beds or large >31 beds) ownership (privately or voluntary owned), and layout. We only interviewed participants living in the four care homes who had previously consented to take part in the OPERA trial. The face-to-face interviews were conducted by one researcher and the interview schedule included questions on what residents' liked or disliked about the design of their care homes including communal spaces (lounges, dining rooms, corridors, entrance halls, gardens) and personal spaces (bedrooms, kitchenettes and en-suite facilities).

Prospective cohort study

We used a prospective cohort design to explore the longitudinal relationship between the physical environment and depressive symptoms of care home residents. We approached 39 care homes from the Midlands (Coventry and Warwickshire) that took part in the OPERA trial and 15 from North East London, due to travel and cost restrictions. Participants who had provided a valid geriatric depression scale (GDS-15) score at baseline in the OPERA trial, were included in the prospective cohort study.

Assessment of Depressive Symptoms

Depressive symptoms were measured using the GDS-15, a 15 item self-report instrument, to measure depressive symptoms (Yesavage & Sheikh, 1986). The short version of the GDS has been well validated and extensively used in care home studies and a score of five or more is often taken to indicate depressive mood (Jongeneelis et al., 2005). GDS-15 was measured at baseline, six months and twelve months.

Assessment of the Physical Environment

The Sheffield Care Environment Assessment Matrix (*SCEAM*) was used to measure the physical environment of the care homes (Parker et al., 2004). The *SCEAM* instrument was specifically developed to measure the physical environment of care homes in the UK, incorporating UK care home building regulations and guidelines. The instrument is intended for use by a non-expert, using direct observation to record if particular design features are present in a care home.

The *SCEAM* instrument measures over 300 features of the physical environment of care homes; ten domains represent how design features of a building allow: *privacy* (43 items), *personalisation* (19 items), *choice and control* (23 items), *community* (18 items), *safety* (60 items), *comfort* (37 items), *support for physical frailty* (42 items), *support for cognitive frailty* (26 items), *awareness of the outside world* (29 items) and *normalness and authenticity* (31 items). For example, the domain *support for physical frailty* assesses the way in which a building supports residents with reduced mobility, such as wheelchair access, continuous handrails and seating along corridors. The domain *privacy* records the extent to which a care home allows residents to remain private, and includes features such as single occupancy private rooms, more than one lounge area, and windows not overlooked by pedestrian routes. Items are recorded as either present (1) or absent (0) and five point scales used to record air quality, cleanliness, light level, smell, sound level and temperature. Domain scores were calculated for each care home as a percentage score of the total number of items, and an overall score calculated by adding together the domain scores and dividing by the number of domains.

Covariates

We adjusted for individual and care home level covariates. Individual level covariates were chosen from data available from the OPERA trial, and chosen because of their potential to be related to depression in care home populations: cognition, social engagement, dependency, age, gender, and length of time resident in the care home. The Mini Mental State Examination (MMSE) was used to measure cognition (Folstein, Folstein, & McHugh, 1975) and is the most widely used measure of cognitive impairment (O'Bryant et al., 2008) with well-established validity and reliability. The Index of Social Engagement (ISE) derived from the Minimum Data Set Resident Assessment Instrument (MDS-RAI) (Mor et al., 1995), is a proxy measure of the involvement of residents in social activities within a care home, and was completed by care staff working in the homes. The Barthel Index (BI), (Mahoney & Barthel, 1965) measures activities of daily living including toileting, feeding, mobility, dressing and incontinence and was also completed by care home staff.

Home level covariates were chosen from observation during *SCEAM* assessments and evidence from a literature review, and included: the location of the care home (Midlands or northeast London), type of care home (nursing or residential), building type (converted or purpose built), home ownership (private or voluntary) and the size of the home (number of beds). A binary variable recorded if the care home was an intervention or control home in

the OPERA trial; an important consideration, as intervention homes received a yearlong exercise programme aimed at reducing depressive symptoms in residents.

Analysis

Data from the interview study were managed using NVivo 9 and we used a thematic framework approach to analyse the data (Ritchie & Spencer, 1994). Familiarisation began during the interview stage whilst listening to participants responses and continued as audio recordings of the interviews were transcribed. The transcribing process, listening to the audio recordings and rechecking the transcripts all contributed to early interpretation of data and generation of themes. Themes began to emerge either directly from responses to themes embedded in the interview schedule or as new themes initiated by responses by participants. A sub-set of transcripts were initially coded to explore the emergent themes and we devised a coding framework that was then applied to all transcripts until it was judged that no new information was acquired. Charting allowed an overall picture of the data to be developed as data was lifted from its original context and rearranged into themes and subthemes. The final stage of framework analysis involved searching for patterns, associations, concepts, and explanations in the data; and we looked for examples from the transcripts to illustrate elements of the themes identified.

We used multilevel models to analyse data for the prospective cohort study. These models are the most appropriate way to accommodate the hierarchical nature of the data and adjust for the clustering effect that group level data may have on individual level data. Residents within care homes are likely to be more similar to each other than residents living in different care homes. For example, residents living in a care home well equipped for wheelchair users may be more physically dependent, or residents living in a care home in a very deprived area may have poorer overall health. The use of statistical methods that do not account for the clustering effect may have under-estimated confidence intervals and lead to incorrect conclusions.

There was a natural hierarchy to the structure of the data collected during the study. The highest level of clustering was at the care home level, with participants nested within care homes, and the repeated measures over time nested within each patient. This structure should be reflected in the analysis. We approached the analysis by proposing a three level model: Level 1 (repeated measure over time), Level 2 (participant level data) and Level 3 (care home level data). Only covariates found to be significant and that significantly improved the fit of the model were added to the model using a forward stepwise approach. The overall fit of the model was compared using the restricted maximum log likelihood (REML). Analyses were done using IBM SPSS (version 18).

Null model

The first step building the model was to construct a null model; that is a model that had no predictor variables but still had the three-level hierarchical structure. The null model partitioned the total variability in the outcome into three components representing the variability at level 1, 2 and 3.

Final Model

The final model was developed by adding covariates to the models and testing their significance. Details of covariates investigated are detailed below, by level of the multi-level model.

Level 1

The time variable was added as a fixed covariate establishing a time profile for each participant (GDS-15 at baseline, six and 12 months).

Level 2

Participant level fixed covariates were then added to the model. Covariates included: gender, age, length of stay in the care home, dependency, social engagement and cognition.

Level 3 (final model)

Care home level covariates were added to the model, these included: type of care home (nursing/residential), building type (converted/purpose built), size of home (number of beds), ownership (private/charity). Variables hypothesised to predict depressive symptoms were then added to the model: the overall *SCEAM* score, each of the 10 *SCEAM* domains and access to the outdoor space (yes/no).

Reliability testing of the SCEAM instrument

The authors of the *SCEAM* instrument report that the measure has high face and content validity (Parker et al., 2004); we conducted further reliability testing for this study. Two independent raters (CR, RP) reassessed 10% of care homes to establish the inter-rater reliability of the measure. One rater (RP) reassessed five care homes (10%) to examine the intra-rater reliability of the measure, with three to six months between assessment dates.

Ethical considerations

Ethical approval was gained as a substantial amendment to the OPERA trial from the Joint UCL/UCLH Committees on the Ethics of Human Research (Committee A), now known as Central London REC 4. The REC reference for the trial is 07/Q0505/56. All care homes gave written informed consent to participate. In line with the Mental Capacity Act (2005), participant consent was obtained if residents were assessed to have capacity to consent to take part in the trial, and for residents who lacked capacity, assent was gained from their next of kin.

Results

Interview study

At the time of the interviews there were 25 residents who had previously taken part in the OPERA trial still living in the four care homes. Of these residents, two were seriously ill, six severely cognitively impaired and two declined to be interviewed. In all 15 residents agreed to participate in the interview study.

The mean age of participants was 85 (range 68-95), 80% were female, and had lived in the home for an average 19 months (range 3-79 months). The mean GDS-15 score was 5.4 (range 2-11) where 0-4 indicates no depressive symptoms, 5-10 moderate depressive symptoms and 11-15 severe depressive symptoms. The mean Mini Mental State Examination (MMSE) score was 23.9 (range 12 – 29).

The main themes to emerge from the interviews relate to: sharing facilities, interior design of the homes, the sensory environment, design promoting independence and control, and the outdoor environment. The five themes are summarised below with brief illustrative quotations.

Sharing facilities – one of the strongest themes to emerge from the interviews was how much participants valued companionship in the care homes and how they favour design features that increase opportunity for social interaction and companionship such as: size and layout of lounges allowing observation of other residents, seating by the entrance to the home, and the layout of dining tables and small group configuration of chairs in lounges promoting conversation.

“I can walk up to the door and sit by the door sometimes, the front door, people will speak as they come in, you know, or go out” Home 4, participant 3

“well they’re in a sort of semi-circle (the chairs), you know, you can sort of sit and talk to two or three people” Home 2, participant 6

Interior design- participants expressed little interest in the décor of the care homes; they appreciated being able to personalise their bedrooms, but reported that bedrooms were often small, restricting space for personal belongings. The layout of the home appeared to influence wayfinding and mobility (long corridors difficult to negotiate for some, a form of exercise for others).

“Do you know I’ve never even considered it? All the decoration, it’s sort of simple, and if there’s a picture on the wall you sort of look at it because it might be of interest...” Home 3, participant 11

“Very long, very long because I do go up and down the corridors ... and I get a bit breathless” Home 4, participant 15

Sensory environment- the sensory environment of care homes evoked both positive and negative responses, with music and TV sounds described positively by some participants, and a disturbance and annoyance by others. Natural light was favoured by most participants, bright artificial lighting, especially in bedrooms disliked. Participants appreciated being able to control the temperature in their bedrooms but some found lounges too hot and avoided them.

“Well, I don’t like it at night when they’ve got their televisions on and I’m trying to get to sleep” Home 2, participant 6

“Very warm, very warm, there is not enough ventilation... Just one of the windows open, because they’re all locked” Home 4, participant 15

Design promoting independence- features of the environment that support function and independence were important to participants such as assistive baths and hand rails and seating along corridors. En-suite facilities were appreciated by those able to use them independently, but physically dependent participants described them as redundant spaces, impractical for those needing a lot of assistance.

“I like it yes. I like the chair to sit in to go in the bath, and they always help me... so I’m happy to have a bath” Home 1, participant 1

“Yes the light on the wall, so I have the lights behind me, but I have them on remote control, my son in law is very good at that, and he put the fan on remote as well” Home 2, participant 7

“No, but I’m not bothered about having en-suite, because I’d need help even if there was en-suite.... No use at all.” Home 3, participant 8

Outdoor environment- Accessibility to outdoor spaces greatly influenced how much they were used by participants, with access compromised to some extent in all four homes: locked doors, needing permission or assistance of staff to go outside, uneven paths and inadequate seating in garden. Participants appreciated the greenery and nature provided in gardens, and referred to past life experiences managing and spending time in gardens.

“Unfortunately I can’t just pop in and out when I want to, that’s the only problem” Home 3, participant 8

“There’s a patio upstairs, with seats on, and there’s a table up there, a little tale with an umbrella you can get under when the weather’s better of course. I used to go up there when I first came, before I had to keep my legs up so much. I mean there’s nowhere up there I could go now to keep my legs up’ Home 4, participant 12

“Oh it’s very pleasant with the rabbits and the birds out there, very pleasant” Home 1, participant 2

The interviews identified a number of features of the physical environment that could potentially affect the mood of older people living in care homes and therefore important to explore further in the prospective cohort study. We considered most of these features to already be captured by the *SCEAM* domains, for example the domain *community* records features of the physical environment that allow opportunity for social interaction, and the domain *support for physical frailty* assesses how the building supports residents with reduced mobility or sensory impairment. The exception was access to outdoor space which is assessed by a single item in the *SCEAM* instrument: *Is the garden/outside areas accessible during the daytime to unaccompanied residents without restriction?* We therefore considered it important to include this additional binary predictor variable in the analysis for the prospective cohort study.

Prospective cohort study

Care homes

In total 50 care homes took part in the prospective cohort study, 36 of 39 approached in the Midlands, and 14 of 15 approached in northeast London. The 50 homes were largely representative of the 323 care homes in the two geographical regions; 40 (80%) were residential homes and 10(20%) nursing homes, 35 (70%) homes were privately owned, 14 (28%) owned by charity or voluntary organisations and one home was owned by a local authority. The size of homes (represented by the number of beds) ranged from 17-47 beds, with a mean of 31 beds. There was only one dementia specialist home included in study, the only dementia specialist home that participated in the OPERA trial.

About a third of the care homes (n=17) were purpose built and two thirds (n= 33) were converted buildings, often former large private residences not specifically designed for older people. The majority of care homes had hotel style layouts with living areas shared by all residents (n=36), others group living layouts with separate lounges and dining areas for particular groups of residents (n=12), and independent living units with restricted movement between building areas (n=2); ten care homes had a dementia specialist unit within the home. Over half of the care homes were more than 60 years old, and seven were built pre 1850.

The mean overall *SCEAM* score for the 50 care homes (calculated simply by adding the 10 domain scores and dividing by the number of domains) was 58.9 (SD 7.1), range 46-74.5 (Table 1). The *SCEAM* domain *cognitive support* has the lowest mean score of 35.2 (SD 10.3), range (13.5-75) suggesting the physical environment of care homes generally provided a low level of support for those with cognitive impairment. The domain *comfort* has the highest mean score of 79.3 (SD 10.2), range 48.6-97.3. The domain *comfort* consists largely of more subjective environmental features such as smell, sound, cleanliness and temperature scored on a 5 point Likert scale. The domain *safety* has a mean score of 78.2 (SD 7.9), range 61-90.7, the small range of scores may reflect the strict safety standards regulations enforced in UK care homes. The domain *personalisation* has a mean score 43.7 (SD 10.6), range 13.2-84.2, the large range of scores indicating the difference in the amount of provision provided by care homes for residents to be able to personalise the care home environment.

Inter-rater reliability of the SCEAM measure

The overall Kappa coefficients for all items were high ranging from .91-.94. Kappa coefficients for binary items scored very highly (.93-.95). Items with ordinal scores had lower kappa coefficients (48-.68).

Intra- rater reliability of the SCEAM measure

The overall Kappa coefficients for all items were high ranging from .90 to .95. Again the kappa coefficients for the binary items were very high (.91-.97) and ordinal items lower ranging from .23 -.80.

Participants

The sample for the prospective cohort study is 510 residents. On average there were 10 study participants per care home, ranging from 4-18 participants. At the time of baseline data collection, 1288 residents were living in the care homes with an 84% bed occupancy rate (Figure 1). About half (51%) of residents did not consent to take part in the OPERA trial and were therefore not included in this study because: the care home manager considered them too ill or not appropriate to take part in the study (15%), resident did not wish to participate (18%), next of kin of residents who lacked capacity to consent did not want them to participate (9%), no reply for request for consent from relatives, or no available next of kin (9%).

Although 628 (49%) participants in the 50 homes consented to take part in the OPERA trial, only 510 (40%) were able to provide a valid GDS-15. The main reason participants were unable to provide a valid GDS-15 was due to cognitive impairment. The 510 residents form the sample for this study. The characteristics of the study population are summarised in table 2. As expected, participants were elderly, mainly female, and had considerable levels of dependency, cognitive impairment and depressive symptoms. At baseline 44.7% of patients had depressive symptoms, indicated by a GDS-15 score of ≥ 5 .

Results of multilevel analysis

Null model

The null model provides the variance components for the GDS-15, with greatest variance attributed between individuals; with 4.6% of the variability in GDS-15 between homes, 57.6% between individuals, and 37.8% within individuals over time. The results support the appropriate use of multilevel analysis as the intraclass correlation coefficient (the proportion of the total variability in the outcome that is attributed to the care homes) was around 5%.

Level 1 (time)

Over time (12 months) levels of depression decreased (-.056), but the change was only small.

Level 2 (participant level covariates)

Age, gender, length of stay, and MMSE were not significantly associated with depressive symptoms. The Barthel Index and the Index of Social Engagement were the only participant level 3 covariates significantly associated with depression and therefore kept in the final model

Level 3 (home level covariates) and final model

Home location, building type (converted or purpose built), ownership, number of beds, overall *SCEAM* score, or any of the *SCEAM* domains were not statistically associated with depressive symptoms. Type of care home (with or with nursing care) and access to outdoor space were the only home level covariates significantly associated with depressive symptoms and kept in the final model.

The results of the final model are summarised in Table 3. Dependency (Barthel Index) was negatively associated with depressive symptoms; with an increase in Barthel Index of one point (0-100) decreasing the GDS-15 by 0.010 points. The Index of Social Engagement was negatively associated with depressive symptoms, with an increase in the Index of Social Engagement of one point (scored 0-6) decreasing the GDS-15 by 0.112 points.

Home type (nursing or residential) was associated with depressive symptoms. The variable 'home type' was a dummy variable coded 0= residential home, 1= nursing home. Mean GDS-15 were 4.18 for residential homes and 5.59 nursing homes. Living in a nursing home rather than a residential home increased depressive symptoms by 1.2 points.

Controlling for level of dependency, social engagement and type of care home, 'access to outdoor space' was the only predictor variable associated with depressive symptoms. The variable 'access to outdoor space' was a dummy variable coded 0= no access to outdoor space, 1 = access to outdoor space. Mean GDS-15 were 3.9 for no access and 4.7 for free access indicating that free access to the outdoor space was associated with depressive symptoms, increasing GDS-15 by .801 points.

Discussion

Care homes can appear to be depressing places, but whether the physical environment directly affects depression in care home residents had not previously been examined. Results of the prospective cohort study indicate that the physical environment alone is unlikely to influence the mood of care home residents. Neither the overall *SCEAM* predictor nor any of the *SCEAM* domain predictor variables were statistically associated with depressive symptoms. These results are supported by the findings from the interview study, where participants spoke positively about the physical environment of the care homes they lived in and did not indicate that the physical environment effected their mood negatively. Participants emphasised features of care home design that increased opportunity for companionship and social interaction and promoted independence and function; and were unconcerned about the décor of the homes they lived in. The implication is that efforts to improve care home environments alone will not be enough to make a significant difference to depressive symptoms in residents.

The predictor variable 'access to outdoor space' was associated with depressive symptoms. The findings however appear counterintuitive with 'access to outdoor space' associated with

an increase in depressive symptoms. From the interview study access to outdoor space was identified as an important additional variable to be included in the prospective cohort study; and assessed using one item from the *SCEAM* instrument: *Is the garden/outside areas accessible during the daytime to unaccompanied residents without restriction?* It is possible that this simple binary item did not capture the complexity of access to gardens and outdoor spaces in care homes. Zeisel et al (2003) report similar difficulties defining and assessing access to gardens.

Findings from the interview study help to understand why 'access to outdoor space' may negatively affect mood. Although participants appreciated greenery and nature in gardens and spoke positively about time spent in gardens and outdoor spaces, the interview study highlighted how access to outdoor spaces in care homes was restricted in many different ways such as needing permission or assistance of staff to go outside, uneven paths and inadequate seating in the garden. Residents may appear to have access to outdoor space but are prevented from using the outdoor space independently due to poor physical or cognitive function, or need the permission of staff to use the outdoors, reasons that may negatively affect residents' perception of autonomy and consequently their mood.

The therapeutic effect of the outdoors for older people is a growing area of research particularly for people with dementia; reported benefits include increased sense of autonomy, increased levels of activity, and reduced agitation (Innes et al., 2011; Whear et al., 2014). Previous studies report that multilevel accommodation, long corridors, stairs, and heavy doors have been found to reduce resident use of outdoor spaces (Cutler & Kane, 2005; Dahlkvist, Nilsson, Skovdahl, & Engström, 2014; Rodiek, Lee, & Nejati, 2014). Staff concern for resident safety and risk of falling means residents in some care homes need to seek the permission of staff to use outdoor spaces (Bengtsson & Carlsson, 2005; Gibson, Chalfont, Clarke, Torrington, & Sixsmith, 2007); and dependent residents have to wait for care staff to be available to take them outdoors (Gibson et al., 2007). Uneven paths, steep steps, limited handrails, inadequate shade and poor seating have also been reported to restrict the use of outdoor space (Innes et al., 2011; Rodiek, 2006); with residents finding the garden depressing because they are too physically impaired to use the outdoor space (Burton & Sheehan, 2010). Patients in a psychiatric unit disliked being able to see a garden that they were unable to use, and conceptualised the idea as "you can look but can't touch" (Payne & May, 2009).

This large prospective cohort study provides new evidence to support the need for unrestricted access to outdoor space in care homes. The implications appear clear, access to outdoor space for residents too frail to access it, may worsen mood. If outdoor space is provided, care homes should ensure that care arrangements mean residents can actually access it.

Unlocked doors to outdoor space is not sufficient; care home design needs to enable residents to access outdoor space independently when possible and provide spaces that are safe, appropriate and comfortable for older people; and promote a culture that optimises the use of outdoor space.

Strength and limitations

This is the first large study to use validated measures of the physical environment and depressive symptoms in a large prospective cohort care home population. The GDS-15 has been well validated and extensively used in care home studies, and additional testing of the *SCEAM* instrument found the instrument to have good overall reliability.

Almost half (44.7%) of residents in the study have depressive symptoms (GDS-15 score of ≥ 5), with a mean GDS-15 score of 4.4 (SD 3), similar to those reported for care home populations in the UK (C. Sutcliffe et al., 2000). The GDS-15 is a self-report measure that has been extensively validated in care home settings (Jongenelis et al., 2005). However, only 40% of residents in the care homes provided a valid GDS-15 at baseline. Many residents were unable to take part in the OPERA trial due to poor health, others declined to take part or were too cognitively impaired, recruitment issues experienced in other UK care home studies (Sackley et al., 2009). The low participation rate will have introduced bias to the study, under representing residents who may have had the highest levels of depressive symptoms. Similarly, participants that died during the twelve month study period may have had higher levels of depressive symptoms. For those participants alive at six and 12 months, there was very little missing data.

The care homes in the study are broadly representative of all care homes in the two regions; but very small and very large care homes, and dementia specialist homes, were underrepresented, as these types of care homes were excluded from the OPERA trial. Though broadly representative of the UK care home sector, we recognise that care home environments differ in different countries and the results of this study may not be applicable in other countries with differing physical environments and care home populations.

The study used a mixed methods approach to explore the complex relationship between the physical environment and depressive symptoms of older people living in care homes allowing a comprehensive evaluation of the research area. The small interview study explored what residents liked and disliked about the design features of care homes and helped to identify which variables were important to include in the prospective cohort study. The interviews confirmed that most of these features were already captured by the SCEAM instrument, but highlighted the need to include the additional binary variable 'access to outdoor space'.

We used multilevel modelling to analyse the data for the prospective cohort study to accommodate the hierarchical nature of the data set and adjust for the clustering effect that the group level data may have had on individual level data; and unlike many other statistical tests, multilevel modelling does not require a balanced data set and copes well with missing data. The analysis controlled for a number of home level and individual level covariates, but because the prospective cohort study relied heavily on existing data from the OPERA trial, it was not possible to control for other potential confounders such as number of care home staff or organisational policy in care homes, or the socio-economic status of participants or reason for entering the care home that may also affect depression in care home residents.

The four care homes that took part in the interview study were purposively selected to be representative of the 50 care homes in the prospective cohort study and provided a wide range of design features that could be discussed with participants. The number of participants in the interview was small but was largely representative of participants in the prospective cohort study in respect to age, gender, but participants were less cognitively impaired and more independent.

Conclusions

The results of this study show that the physical environment alone is unlikely to significantly influence mood in care home residents. We provide new evidence to suggest that access to outdoor space predicts depressive symptoms in older people living in care home.

Interventions aimed at increasing access to outdoor spaces could positively affect depressive symptoms in older people.

Acknowledgments

We thank the care home owners, managers and care staff who participated in the study, the authors of the Sheffield Care Environment Assessment Matrix who gave permission to use the *SCEAM* instrument, and the National Institute for Health Research Health Technology Assessment programme who funded the OPERA trial (project 06/02/01). This work was supported by the EPSRC grant Participation in Healthcare Environment Engineering [EP/H022031/1]. Due to the ethically sensitive nature of the research no participants consented to their data being shared.

References

- Achterberg, W., Pot, A. M., Kerkstra, A., Ooms, M., Muller, M., & Ribbe, M. (2003). The Effect of Depression on Social Engagement in Newly Admitted Dutch Nursing Home Residents. *The Gerontologist*, 43(2), 213-218. doi: 10.1093/geront/43.2.213
- Anderiesen, H., Scherder, E. J., Goossens, R. H., & Sonneveld, M. H. (2014). A systematic review--physical activity in dementia: the influence of the nursing home environment. *Appl Ergon*, 45(6), 1678-1686. doi: 10.1016/j.apergo.2014.05.011
- Bengtsson, A., & Carlsson, G. (2005). Outdoor environments at three nursing homes: focus group interviews with staff. *Journal of Housing for the Elderly*, 19(3/4), 49-69.
- Burton, E., & Sheehan, B. (2010). Care home environments and wellbeing: identifying the design features that most affect older residents. *Journal of Architecture and Planning Research*, 27(3), 237-256.
- Choi, N. G., Ransom, S., & Wyllie, R. J. (2008). Depression in older nursing home residents: the influence of nursing home environmental stressors, coping, and acceptance of group and individual therapy. *Aging & Mental Health*, 12(5), 536-547.
- Cuijpers, P., & Van Lammeren, P. (1999). Depressive symptoms in chronically ill elderly people in residential homes. *Aging & Mental Health*, 3(3), 221 - 226.
- Cutler, L. J., & Kane, R. A. (2005). As great as all outdoors: a study of outdoor spaces as a neglected resource for nursing home residents. *Journal of Housing for the Elderly*, 19(3/4), 29-48.
- Dahlkvist, E., Nilsson, A., Skovdahl, K., & Engström, M. (2014). Is There a Caring Perspective in Garden/Patio Design in Elderly Care? A Description and a Comparison of Residents' and Staff Members' Perceptions of These Outdoor Spaces. *Journal of Housing for the Elderly*, 28(1), 85-106. doi: 10.1080/02763893.2013.858094
- Davison, T. E., McCabe, M. P., Mellor, D., Ski, C., George, K., & Moore, K. A. (2007). The prevalence and recognition of major depression among low-level aged care residents with and without cognitive impairment. *Aging & Mental Health*, 11(1), 82-88. doi: 10.1080/13607860600736109
- Eisses, A. M., Kluiter, H., Jongenelis, K., Pot, A. M., Beekman, A. T., & Ormel, J. (2004). Risk indicators of depression in residential homes. *Int J Geriatr Psychiatry*, 19(7), 634-640. doi: 10.1002/gps.1137
- Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). "Mini-mental state" : A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12(3), 189-198.
- Garre-Olmo, J., Lopez-Pousa, S., Turon-Estrada, A., Juvinya, D., Ballester, D., & Vilalta-Franch, J. (2012). Environmental determinants of quality of life in nursing home residents with severe dementia. *J Am Geriatr Soc*, 60(7), 1230-1236. doi: 10.1111/j.1532-5415.2012.04040.x
- Gibson, G., Chalfont, G. E., Clarke, P. D., Torrington, J. M., & Sixsmith, A. J. (2007). Housing and Connection to Nature for People with Dementia - Findings from the INDEPENDENT Project. *Journal of Housing for the Elderly*, 21(1), 55 - 72.
- Help The Aged. (2008). Help the Aged 2008 Residential Care Briefing. London.

- Innes, A., Kelly, F., Dincarslan, O., Innes, A., Kelly, F., & Dincarslan, O. (2011). Care home design for people with dementia: What do people with dementia and their family carers value? *Aging & Mental Health*, 15(5), 548-556.
- Jongenelis, K., Pot, A. M., Eisses, A. M., Beekman, A. T., Kluiters, H., & Ribbe, M. W. (2004). Prevalence and risk indicators of depression in elderly nursing home patients: the AGED study. *J Affect Disord*, 83(2-3), 135-142.
- Jongenelis, K., Pot, A. M., Eisses, A. M., Gerritsen, D. L., Derksen, M., Beekman, A. T., . . . Ribbe, M. W. (2005). Diagnostic accuracy of the original 30-item and shortened versions of the Geriatric Depression Scale in nursing home patients. *Int J Geriatr Psychiatry*, 20(11), 1067-1074. doi: 10.1002/gps.1398
- Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process *Psychology of adult development and aging* (pp. 619-674). Washington DC: American Psychological Association.
- Lievesley, N., Crosby, G., & Bowman, C. (2011). The Changing Role of Care Homes. London: BUPA and Centre for Policy on Ageing.
- Llewellyn-Jones, R. H., Baikie, K. A., Smithers, H., Cohen, J., Snowden, J., & Tennant, C. C. (1999). Multifaceted shared care intervention for late life depression in residential care: randomised controlled trial. *BMJ (Clinical research ed.)*, 319(7211), 676-682.
- Mahoney, F., & Barthel, D. (1965). Functional evaluation: the Barthel Index. *Maryland State Med J*, 14, 61-65.
- Mann, A. H., Graham, N., & Ashby, D. (1984). Psychiatric illness in residential homes for the elderly: a survey in one London borough. *Age and Ageing*, 13(5), 257-265.
- Mor, V., Branco, K., Fleishman, J., Hawes, C., Phillips, C., Morris, J., & Fries, B. (1995). The Structure of Social Engagement among Nursing Home Residents. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 50B(1), P1-P8. doi: 10.1093/geronb/50B.1.P1
- O'Bryant, S. E., Humphreys, J. D., Smith, G. E., Ivnik, R. J., Graff-Radford, N. R., Petersen, R. C., & Lucas, J. A. (2008). Detecting Dementia With the Mini-Mental State Examination in Highly Educated Individuals. *Arch Neurol*, 65(7), 963-967. doi: 10.1001/archneur.65.7.963
- Office for National Statistics. (2014). Changes in the Older Resident Care Home Population between 2001 and 2011. 2016, from <https://www.ons.gov.uk/>
- Papoulias, C., Csipke, E., Rose, D., McKellar, S., & Wykes, T. (2014). The psychiatric ward as a therapeutic space: systematic review. *The British Journal of Psychiatry*, 205(3), 171-176. doi: 10.1192/bjp.bp.114.144873
- Parker, C., Barnes, S., McKee, K., Morgan, K., Torrington, J., & Tregenza, P. (2004). Quality of life and building design in residential and nursing homes for older people. *Ageing & Society*, 24(06), 941-962.
- Payne, H., & May, D. (2009). Evaluation of a refurbishment scheme incorporating the King's Fund "Enhancing the Healing Environment" design principles. *Journal of Facilities Management*, 7(1), 74-89.
- Riemersma-van der Lek, R. F., Swaab, D. F., Twisk, J., Hol, E. M., Hoogendijk, W. J. G., & Van Someren, E. J. W. (2008). Effect of Bright Light and Melatonin on Cognitive and Noncognitive Function in Elderly Residents of Group Care Facilities. *JAMA: The Journal of the American Medical Association*, 299(22), 2642-2655. doi: 10.1001/jama.299.22.2642
- Ritchie, & Spencer. (1994). Qualitative data analysis for applied policy research *Analysing Qualitative Data*: London, Routledge p.173-194.

- Rodiek, S. (2006). Resident Perceptions of Physical Environment Features that Influence Outdoor Usage at Assisted Living Facilities. *Journal of Housing for the Elderly*, 19(3-4), 95-107. doi: 10.1300/J081v19n03_06
- Rodiek, S., Lee, C., & Nejati, A. (2014). You Can't Get There From Here: Reaching the Outdoors in Senior Housing. *Journal of Housing for the Elderly*, 28(1), 63-84. doi: 10.1080/02763893.2013.858093
- Sackley, C. M., Berg, M. E. v. d., Lett, K., Patel, S., Hollands, K., Wright, C. C., & Hoppitt, T. J. (2009). Effects of a physiotherapy and occupational therapy intervention on mobility and activity in care home residents: a cluster randomised controlled trial. *BMJ*, 339. doi: 10.1136/bmj.b3123
- Sutcliffe, Burns, A., Challis, D., Mozley, C., Cordingley, L., Bagley, H., & Huxley, P. (2007). Depressed Mood, Cognitive Impairment, and Survival in Older People Admitted to Care Homes in England. *American Journal of Geriatric Psychiatry*, 15(8), 708-715.
- Sutcliffe, C., Cordingley, L., Burns, A., Mozley, C. G., Bagley, H., Huxley, P., & Challis, D. (2000). A New Version of the Geriatric Depression Scale for Nursing and Residential Home Populations: The Geriatric Depression Scale (Residential) (GDS-12R). *International Psychogeriatrics*, 12(02), 173-181.
- Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 224, 420-421.
- Underwood, M., Eldridge, S., Lamb, S., Potter, R., Sheehan, B., Slowther, A.-M., . . . Weich, S. (2011). The OPERA trial: protocol for a randomised trial of an exercise intervention for older people in residential and nursing accommodation. *Trials*, 12(1), 27.
- Underwood, M., Lamb, S. E., Eldridge, S., Sheehan, B., Slowther, A.-M., Spencer, A., . . . Taylor, S. J. C. (2013). Exercise for depression in elderly residents of care homes: a cluster-randomised controlled trial. *The Lancet*, 382(9886), 41-49. doi: [http://dx.doi.org/10.1016/S0140-6736\(13\)60649-2](http://dx.doi.org/10.1016/S0140-6736(13)60649-2)
- Whear, R., Coon, J. T., Bethel, A., Abbott, R., Stein, K., & Garside, R. (2014). What Is the Impact of Using Outdoor Spaces Such as Gardens on the Physical and Mental Well-Being of Those With Dementia? A Systematic Review of Quantitative and Qualitative Evidence. *Journal of the American Medical Directors Association*. doi: 10.1016/j.jamda.2014.05.013
- Yesavage, J. A., & Sheikh, J. I. (1986). Geriatric Depression Scale (GDS) Recent Evidence and Development of a Shorter Version. *Clinical Gerontologist*, 5(1), 165 - 173.
- Zeisel, J., Silverstein, N. M., Hyde, J., Levkoff, S., Lawton, M. P., & Holmes, W. (2003). Environmental Correlates to Behavioral Health Outcomes in Alzheimer's Special Care Units. *The Gerontologist*, 43(5), 697-711.

Table 1. Mean *SCEAM* scores

Domain	Mean	Std. Dev.	Range	Minimum	Maximum
Privacy	65.63	09.67	38.4	46.5	84.9
Personalisation	43.68	10.60	71.1	13.2	84.2
Choice	48.52	15.03	63.0	13.0	76.1
Community	63.00	10.69	38.9	44.4	83.3
Safety	78.19	07.91	29.7	61.0	90.7
Physical Support	60.71	14.64	64.6	26.8	91.5
Comfort	79.32	10.19	48.6	48.6	97.3
Cognitive Support	35.19	10.30	61.5	13.5	75.0
Awareness	52.28	09.74	41.4	32.8	74.1
Normalness	62.19	10.46	48.4	37.1	85.5
Overall score	58.87	07.11	28.5	46.0	74.5

Figure 1 Participants in the care homes with a valid GDS-15 at baseline

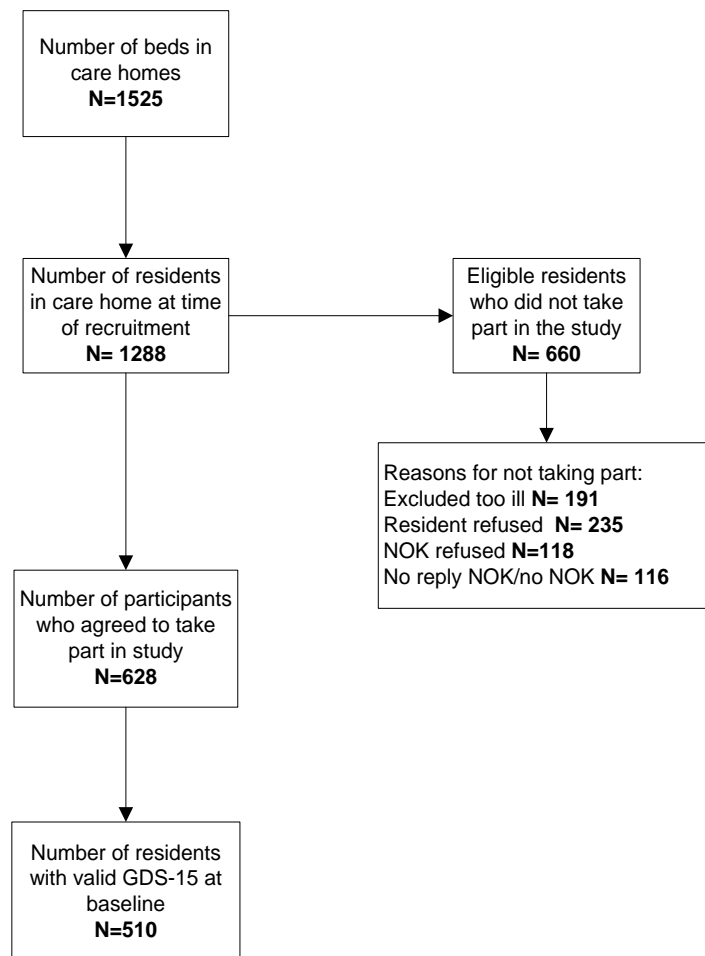


Table 2. Baseline characteristics of study participants, missing data and follow up rates.

Study participants	
Number	510
Age (years)	
Mean (SD)	86.4 (7.3)
Range	65-107
Gender	
Male	117 (23%)
Female	393 (77%)
Length of stay in care home (months)	
Mean (SD)	28 (30.1)
Missing	8
Mini Mental State Examination (0-30)	
Mean (SD)	18 (7)
Missing	23
Barthel Index (0-100, 100 best)	
Mean(SD)	60.1 (26.7)
Missing	2
Index of Social Engagement (0-6)	
Mean(SD)	4.6 (1.8)
Missing	14
Baseline GDS-15 (0-15)	
Mean(SD)	4.4 (3)
Missing	0
6 month GDS-15	
Mean(SD)	4.2 (3)
Missing (%)	138 (27%)
12 month GDS-15	
Mean(SD)	4.2 (3)
Missing (%)	179 (35%)

Table 3. Final model

Fixed Effects	Estimate (se)	p value	95% CI
Intercept	4.785 (.481)		
Time	-0.56 (.087)		
Barthel Index	-.010 (.005)	0.280	-.02, -.001
Social Interaction	-.112 (.068)	1.000	-.25, .021
Home type	1.200 (.350)	.001	.50, 1.9
Access to outdoor space	.801 (.272)	.005	.25, 1.35
Random effects	Variance	Standard error	
Variance (ε)	8.847	.458	
Variance (u)	.135	.169	